Indian J. Plant Physiol., Vol. 11, No. 2, (N.S.) pp. 217-221 (April-June, 2006)

SHORT COMMUNICATION

EFFECT OF PHYTOHORMONES ON GROWTH, AND YIELD OF BLACK CUMIN (*NIGELLA SATIVA* L.)

S.H. SHAH* AND SAMIULLAH

Department of Botany, Aligarh Muslim University, Aligarh 202 002

Received on 23 Feb., 2006

A pot trial was carried out to study the effect of foliar spray of 0 (de-ionized water), 10^{-6}, 10^{-5} and 10^{-4} M each of gibberellic acid (GA_3) or Kinetin (KIN) at 40 days after sowing (vegetative stage) on growth and yield of black cumin (*Nigella sativa* L.). GA_3 application at 10^{-5} M concentration was found to be more effective than KIN in promoting shoot length, plant dry weight, leaf number, leaf area and branch number observed 70 days after sowing (DAS). Application of 10^{-5} M GA_3 resulted in more capsule number, seed yield and seed yield merit, which was found increased by 43.33, 43.85 and 53.62% respectively.

Key words: **Black cumin, gibberellic acid, growth, kinetin, yield.**

India is home to a number of spices, prominent among which is black cumin (*Nigella sativa* L.), locally known as ‘kalonji’. The herb is extensively used in food as well as medicinal formulations (Saleh Al-Jassir 1992). It has a high remedial value as a carminative, stimulant, diaphoretic, emanagogue and galactagogue, as well as in curing gastrointestinal disorders, urinary tract infections, kidney or bladder stones, toothache (Riaz *et al.* 1996) and even cancer (Salomi *et al.* 1989). Ironically the economic cultivation of this miraculous herb has not been realized. Most of its supply still comes from wild resources. These is a need to augment its productivity to cope with the increasing demand. In this context, the use of growth regulators particularly KIN and GA_3 could be useful, as they have been shown to possess potential to enhance crop productivity (De-La-Guardia and Benlloch, 1980, Mousa *et al.* 2001, Khan *et al.* 2002). Therefore, this study was aimed at comparing and characterizing the effects of GA_3 and KIN on the growth and yield of black cumin.

A completely randomized block design experiment was carried out at the Department of Botany, Aligarh Muslim University, Aligarh (27° 53´ N, 78° 41´ E and 187.45 m) during the winter season. The soil of the experimental pots was slightly alkaline, sandy loam in texture and moderate in available N, P and K. A uniform basal dose (450, 300 and 78 mg) of N, P and K, in the form of urea, single superphosphate and muriate of potash, was applied at the time of sowing in each pot. Seeds were obtained from the Regional Research Institute of Unani Medicine, Aligarh. They were surface sterilized with 0.01% mercuric chloride solution followed by repeated washings, using double distilled water. The seeds were then sown in earthen pots (25 cm diam) filled with soil and farmyard manure, mixed in a ratio of 9:1. At 40 days after sowing (vegetative stage), the plants were sprayed with 10^{-6}, 10^{-5} or 10^{-4} M each of GA_3 or KIN at the rate of 5 cm^3 $plant^{-1}$. The control set was sprayed with de-ionized water and each treatment was replicated thrice.

*Corresponding author.

Observations were recorded for shoot length, leaf number, leaf area, dry weight and branch number plant^{-1}. Leaf area was calculated according to Watson (1958). Dry weight was recorded by drying the plants at 80°C until constant weight. At maturity (130 DAS), capsules plant^{-1}, seeds capsule^{-1}, 100-seed weight, seed yield plant^{-1} and harvest index (HI) were determined. Three plants from each treatment were removed and capsule number was recorded. Random samples were taken from threshed seeds for determination of 100-seed weight. The seed yield from three randomly selected plants was noted after threshing the seeds. Harvest index

Table 1. Effect of phytohormones applied at 40 days after sowing (DAS) on shoot length, leaf number, leaf area, dry weight and branch number plant^{-1} of *Nigella sativa* L. at 70 DAS

Phytohormones	**Molar concentrations (C)**				
(P)	**0**	**10^{-6}**	**10^{-5}**	**10^{-4}**	**Mean**
			Shoot length plant^{-1} (cm)		
Kinetin	42.21	51.25	66.11	65.13	56.18
GA_3	44.51	60.24	78.51	75.12	64.60
Mean	43.36	55.75	72.31	70.13	
L.S.D. at 5%	P=2.4	C=2.8	PxC= 5.1		
			Leaf number plant^{-1}		
Kinetin	28.02	32.10	37.81	36.62	33.64
GA_3	29.01	34.71	42.15	40.02	36.47
Mean	28.51	33.41	39.98	38.32	
L.S.D. at 5%	P=2.1	C=2.4	PxC= 4.1		
			Leaf area (cm^2 plant^{-1})		
Kinetin	285.11	333.41	385.12	370.14	343.45
GA_3	295.16	354.11	430.25	412.17	372.92
Mean	290.13	343.76	407.68	391.15	
L.S.D. at 5%	P=21.2	C=24.2	PxC= 42.3		
			Dry weight (g plant^{-1})		
Kinetin	1.66	1.98	2.48	2.39	2.13
GA_3	1.78	2.24	2.83	2.79	2.41
Mean	1.72	2.11	2.66	2.59	
L.S.D. at 5%	P=0.18	C=0.21	PxC= 0.36		
			Branch number plant^{-1}		
Kinetin	7.60	8.62	9.95	9.38	8.89
GA_3	7.55	9.05	10.90	10.50	9.50
Mean	7.57	8.83	10.43	9.94	
L.S.D. at 5%	P=0.41	C=0.52	PxC= 0.71		

Indian J. Plant Physiol., Vol. 11, No. 2, (N.S.) pp. 217-221 (April-June, 2006)

Table 2. Effect of phytohormones applied at 40 days after sowing (DAS) on yield attributes of *Nigella sativa* L.

Phytohormones	**Molar concentrations (C)**				
(P)	**0**	**10^{-6}**	**10^{-5}**	**10^{-4}**	**Mean**
			Capsules plant^{-1}		
Kinetin	16.20	18.35	21.5	20.90	19.24
GA_3	16.51	19.70	23.75	23.01	20.74
Mean	16.36	19.02	22.62	21.96	
L.S.D. at 5%	P=1.0	C=1.2	PxC= 2.1		
			100-seed weight (mg)^{1}		
Kinetin	245	240	251	245	245.3
GA_3	250	245	255	252	250.5
Mean	247.5	242.5	253.0	248.5	
L.S.D. at 5%	P=NS	C=NS	PxC= NS		
			Seeds capsule^{-1}		
Kinetin	52.10	52.90	54.01	53.701	53.18
GA_3	52.01	53.12	55.22	55.74	54.02
Mean	51.05	53.014	54.61	54.72	
L.S.D. at 5%	P=NS	C=NS	PxC= NS		
			Seed yield (g plant^{-1})		
Kinetin	1.12	1.25	1.50	1.41	1.32
GA_3	1.20	1.32	1.72	1.52	1.44
Mean	1.16	1.29	1.61	1.74	
L.S.D. at 5%	P=0.10	C=0.12	PxC= 0.21		
			Harvest index (%)		
Kinetin	40.35	41.50	42.85	43.03	41.93
GA_3	40.50	41.92	43.41	42.86	42.17
Mean	40.42	41.71	43.13	42.95	
L.S.D. at 5%	P=0.18	C=0.26	PxC= 0.37		
			Seed yield merit		
Kinetin	45.36	51.87	64.37	60.67	55.57
GA_3	48.60	55.33	74.66	65.14	60.93
Mean	46.98	53.6	69.51	62.90	
L.S.D. at 5%	P=2.3	C=2.9	PxC= 4.7		

NS=not significant

was determined by dividing the seed yield by the biological yield. Seed yield merit (SYM) was obtained using the method given by Imsande (1992). Analysis of variance was carried out and LSD (P=0.05) was calculated (Gomez and Gomez 1984).

The study revealed that application of GA_3 or KIN at 10^{-5} M concentration was most promotive for shoot length, plant dry weight, leaf number, leaf area, and branch number $plant^{-1}$, in comparison with all other treatments of GA_3 or KIN, which proved either ineffective or supra-optimal. However, the effect of KIN was comparatively subdued, which may be, because endogeous cytokinin is seldom limiting in crop plants (Moore 1989) and hence, exogenously applied KIN seems relatively less effective.

GA_3 is a well known causative of wall extensibility (Huttly and Phillips 1995), leading to cell expansion, elongation of internodes (Moore 1989) and ultimately increased shoot length (Table 1). Moreover, GA_3 also induces leaf area expansion (Brock 1993), also observed in this study (Table 1), which inturn manifests itself in the form of more dry matter (Table 1). This postulation is supplemented by the observed strong positive correlation between leaf area and dry matter ($r=0.921^{**}$). Similar stimulatory effects of KIN on the aforesaid parameters, can be likewise accounted by the promotion of the growth of new buds and tillers due to cytokinins (Bruinsma 1977) and the stimulation of cell division and enlargement by KIN (Jablonski and Skoog 1954, Miller 1955).

With reference to various yield, attributing characters taken under study, viz. number of capsules, seed yield, harvest index (HI) and seed yield merit (Table 2), GA_3 was found to outperform KIN, with 10^{-5} M concentration of both hormones proving relatively more effective than others. On the contrary, 100-seed weight and number of seeds $capsule^{-1}$ were not influenced. Such finding is in accordance with that of Khan *et al.* (1998, 2002). The influence of GA_3 on the above mentioned parameters may be ascribed to the stimulation of growth causing an overall increase in yield (Sawan *et al.* 1988). KIN also increased the formation of new capsules through prevention of pre-mature abortion of flowers and pods (Nagel 2001), resulting in increased overall yield at maturity.

REFERENCES

Brock, T.G. (1993). Combined effects of hormones and light during growth promotion in primary leaves of *Phaseolus vulgaris*. *Can. J. Bot.* **71:** 501-505.

Bruinsma, J. (1977). Roller der cytokinine bei Blüten-und Fruchtentwicklung. Z. Pflanzenernähr. *Bodenk* **140:** 15-23.

De La Gaurdia, M.D. and Benlloch, M. (1980). Effect of potassium and gibberellic acid on stem growth of whole sunflower plants. *Physiol. Plant.* **49:** 443-448.

Gomez, K.A. and Gomez, A.A. (1984). Statistical Procedures for Agricultural Research. J. Wiley and Sons, New York.

Huttly, A.K. and Phillips, A.L. (1995). Gibberellin regulated plant genes. *Physiol. Plant.* **95:** 310-317.

Imsande, J. (1992). Agronomic characteristics that identify high yield, high protein content in soybean genotypes. *Agron. J.* **84:** 409-414.

Jablonski, Jr. and Skoog, F. (1954). Cell enlargement and cell division in excised tobacco pith tissue. *Physiol. Plant*. **7:** 16-24.

Khan, N.A., Ansari, H.R. and Samiullah (1998). Effect of gibberellic acid spray during ontogeny of mustard on growth, nutrient uptake and yield characteristics. *J. Agron. Crop Sci.* **181:** 61-63.

Khan, N.A., Ansari, H.R., Khan, M., Mir, R. and Samiullah (2002). Effect of phytohormones on growth and yield of Indian mustard. *Indian J. Plant Physiol.* **7:** 75-78.

Miller, C.O., Skoog, F., Von Saltza, M.H. and Strong, F.M. (1955). Kinetin, a cell division factor from deoxyribonucleic acid. *J. Am. Chem. Soc.* **77:** 1392.

Moore, T.C. (1989). Biochemistry and Physiology of Plant Hormones. Springer Verlag, New York.

Mousa, G.T., El-Sallami, I.H. and Ali, E.F. (2001). Response of *Nigella sativa* L. to foliar application of gibberellic acid, benzyladenine, iron and zinc. *Assiut J. Agric. Sci.* **32:** 141-156.

Nagel, L., Brewster, R., Riedell, W.E. and Reese, R.N. (2001). Cytokinin regulation of flower and pod set in soybeans (*Glycine max* (L.) Merr.). *Ann. Bot.* **88:** 27-31.

Riaz, M., Syed, M. and Chaudhary, F.M. (1996). Chemistry of the medicinal plants of the genus Nigella. *Hamdard Medicus* **39:** 40-45.

Saleh Al-Jassir, M. (1992). Chemical composition and microflora of black cumin (*Nigella sativa* L.) seeds growing in Saudi Arabia. *Food Chem.* **45:** 239-242.

Salomi, M.J., Panikkar, K.R., Kesavan, M., Donanana, S.R. and Rajgopalan, K. (1989). Anticancer activity of *Nigella sativa* L. *Ancient Sci. Life* **8:** 262-266.

Sawan, Z.M., El-Farra, A.A. and Abdel-Latif, S. (1988). Cotton seed protein and oil yields and oil properties as affected by N and P fertilization and growth regulators. *J. Agron. Crop Sci.* **16:** 50-56.

Watson, D.I. (1958). The dependence of net assimilation rate of leaf area index. *Ann. Bot.* **22:** 37-54.